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A MODIFICATION IN THE DETERMINATION OF MALIC ACID.

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The accurate method for determining malic acid offered by Dunbar and Bacon [1] presents some difficulties in manipulation. These, briefly, are the slowness with which the various liquids filter and the great difficulty in always obtaining solutions sufficiently clear and free from small particles for polarizing. The lead salts have a tendency to pass through the filter, especially with certain types of fruit of low acidity.

The chief cause of this slow filtration is the presence of pectin bodies, always present in fruit juices to a greater or less extent. They rapidly clog the pores of the paper, and if present in sufficient amount will entirely stop the flow. Dilution helps the filtration, but introduces errors, especially when the malic acid content is originally low. The whole difficulty is avoided by the following preliminary treatment.

A weighed amount of juice, generally 100 grams, is placed in a 500 cc beaker. With vigorous stirring about two or three times the volume of 95 per cent alcohol is added. This throws out the pectin bodies, usually in such a form that after standing a few minutes they may be gathered into a coherent mass. The liquid is decanted through a filter and the precipitate washed twice with 95 per cent alcohol. The combined filtrates are then evaporated in a current of air on the water bath to about 75 cc. After cooling, the solution is made up to 100 cc in a measuring flask, using 10 to 15 cc of 95 per cent alcohol and distilled water. The temperature when the volume is finally made up to the mark should be close to that at which the polariscope readings are to be taken. This solution is then treated exactly as in the original method, except that no clarification is necessary. No difficulty will be experienced in filtering, as the liquid passes rapidly through the paper and has no tendency to clog.

The addition of alcohol in making up to volume has a twofold purpose. Lead malate is less soluble in an alcoholic solution, and the necessity of cooling with ice to remove it completely is, therefore, avoided. The chief advantage, however, lies in the fact that the

[1] U. S. Dept. Agr., Bureau of Chemistry Cir. 76.

lead salts of fruit acids are thrown out in the alcohol-containing liquid as gelatinous precipitates which filter quickly and never cause trouble by passing through the paper unless a large excess of lead acetate has been used in the precipitation. This should always be avoided by adding it in small amounts with vigorous shaking after each addition until a few crystals remain unchanged at the bottom of the flask. When the powdered anhydrous sodium sulphate is added to remove the excess of lead the same advantage is noted. In this case without the alcohol even more trouble is encountered in obtaining a filtrate entirely clear and free from small particles that render it very difficult to polarize. With the alcohol, one or at most two filtrations give a water clear solution that may be read in a 200 mm tube.

With that part of the solution containing the uranyl acetate a liquid is obtained which filters rapidly and can always be read in a 100 mm tube. In cases where the alcohol has caused some fruit color to pass into solution the addition of a tiny drop of bromin and vigorous shaking and filtering, if necessary, before reading will give satisfactory results.

The modification has been thoroughly tested in the routine analysis of a large number of fruit samples. By this means, for instance, the thick mass resulting from crushed bananas may be handled. Here the malic acid content is rather low, and the solution would have to be so diluted in order to handle it in the ordinary way that the errors would be relatively large.

Another advantage of this method of procedure is that concentration of the original juice is possible. Two hundred grams may be used, and the final volume after evaporation made up as usual to 100 cc. With juices containing but little malic acid this is a great advantage, which could not be utilized in the original method. The time required to precipitate the pectins, filter, and evaporate off the alcohol is more than compensated for by the time saved in filtering the solution, and the use of longer tubes in the polariscope increases the accuracy of the method.

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